

# The Laparoscopic Retrieval of an Orthopedic Fixation Pin from the Liver with Repair of an Associated Diaphragmatic Laceration

Anthony C. Antonacci, MD, James Rosser, MD

## ABSTRACT

We report the successful removal of a shoulder fixation pin from the right lobe of the liver with intracorporeal repair of a diaphragmatic laceration. An expeditious workup and urgent operative intervention were required. We adhered to the principles of room setup, optical correctness, establishment of the triangle of success, appropriate instrument entry and convergence angles, two-handed surgical skills, and competence in intracorporeal suturing techniques that were all required for successful completion of the case.

We also present a review of the significant literature.

**Key Words:** Laparoscopy, Fixation pin, Migration, Liver, Laceration, Diaphragm.

## INTRODUCTION

Pins and wires have long been used in orthopedics for the efficient management of fractures and dislocations. Anecdotal reports of the migration of such devices to sites quite distant to the original point of fixation are well described and are, at times, quite startling in their seriousness. We report here the migration over a three to five day period of time of one of three shoulder fixation pins through the right chest and right diaphragm to lodge in the right lobe of the liver. We also present a review of the significant literature and the laparoscopic management of this case.

## CASE REPORT

L.R. is a 78-year-old white female who sought treatment ten days after a fall sustaining an impacted fracture of her right shoulder. The patient was evaluated in the orthopedics department and three percutaneous fixation (9 cm) pins were placed under fluoroscopic guidance (**Figure 1**). The fixation was deemed satisfactory. The pin ends were secured with standard plastic fixation caps and the wounds were sterilely dressed. The patient was treated with a sling and swath for a planned 3-week immobilization. Approximately 8 days postoperatively, the patient noted some right sided chest discomfort that she attributed to rib injuries associated with her fall. She had a routine follow-up visit scheduled with her orthopedist in two days and elected to wait until that time to be evaluated. She denied shortness of breath or dyspnea on exertion, but did admit to discomfort on deep breathing. On the 10th postoperative day, the patient presented for her visit and underwent a routine right shoulder X-ray to evaluate the fracture site (**Figure 2**). Subsequent X-rays demonstrated migration of one of the fixation pins from the right shoulder through the right chest and diaphragm to lodge in the right lobe of the liver. The patient was brought to the Singer Division of The Beth Israel Medical Center for evaluation. Her history and physical examination were normal except for slightly diminished breath sounds on the right with poor inspiration secondary to pain. Her vital signs were stable, and the abdominal examination was completely normal. A CT scan with IV contrast was performed. The results

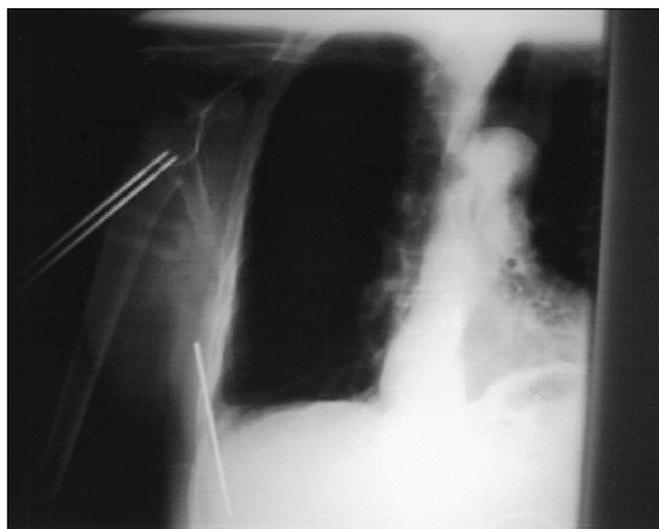
The Beth Israel Medical Center, New York, New York, USA (Dr Antonacci).  
Yale University School of Medicine, New Haven, Connecticut, USA (Dr Rosser).

Address reprint requests to: Anthony C. Antonacci MD, 170 E. End Avenue, Suite 400, New York, NY 10028, USA. Telephone: (212) 794-5000, Fax: (212) 861-0859

© 2001 by JSLS, *Journal of the Society of Laparoendoscopic Surgeons*. Published by the Society of Laparoendoscopic Surgeons, Inc.



**Figure 1.** Original X-ray of pin placement.

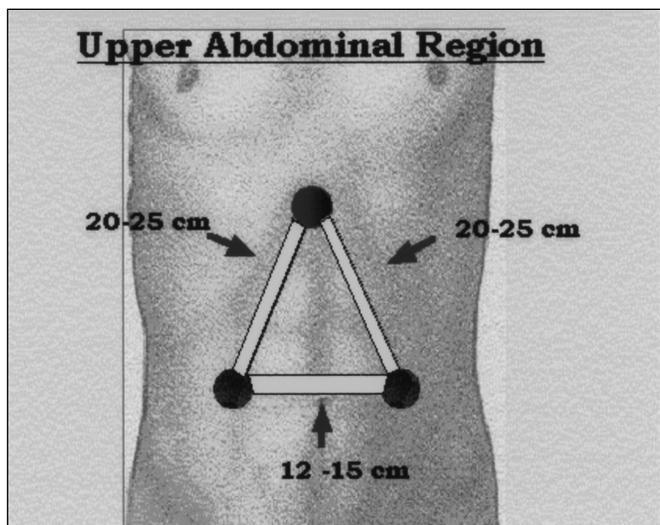


**Figure 2.** Post pin migration X-ray.

demonstrated a 9.6 cm metallic foreign body representing one of the fixation pins transiting the right chest and entering the right lobe of the liver in a postero-lateral oblique angle. The tip of the pin appeared confined to the liver at the time of the examination. The patient was taken to the operating room for a planned laparoscopic exploration.

### Operative Preparation

The patient was prepped to include both the chest and abdomen, and the operating team was prepared to place a chest tube if needed. The patient was successfully induced with general anesthesia with no change in inspiratory pressures. Laparoscopy was achieved via a Hassan approach through the umbilicus. The patient was placed in the reverse Trendelenburg position and rotated to the left to achieve maximal exposure of the right infradiaphragmatic space. Two additional trocar sites were placed. The first trocar was placed to the right of the falciform ligament two thirds of the way between the umbilicus and the xiphoid. The second trocar was placed on the lateral border of the right rectus sheath approximately 3 to 4 fingerbreadths below the costal margin. Care was taken to ensure that the sides of the triangle were 20 to 25 cm from the foreign body (**Figure 3**) and the base of the triangle had approximately 12 to 15 cm of separation between trocar sites. A 30-degree laparoscope was used and the area of injury evaluated. A 10-mm trocar was used in the nondominant hand position in preparation for the passage of intracorporeal sutures.<sup>1</sup> The lateral aspect of the liver was examined, and no evidence of retroperitoneal injury was found. The diaphragm was lifted off of the end of the pin so as not to disturb the pin's position in the liver. The pin was extricated from the liver parenchyma taking care not to damage the diaphragm or suprahepatic inferior vena cava. The pin was successfully retrieved via a trocar site. The area of the diaphragmatic injury was inspected and closed with a single intracorporeal suture of 2-O Surgidek (USSC; Norwalk, CT). Inspiratory pressures began to elevate as expected from the transit of abdominal CO<sub>2</sub> into the chest and a #20 tube thorocostomy was placed with full expansion of the lung and normalization of inspiratory pressures. The lateral and inferior aspects of the right lobe of the liver were inspected and adhesions were found, but no evidence existed of retroperitoneal hematoma. No bleeding occurred from the liver laceration. The wound was irrigated, and the port sites were closed under direct vision with a Carter-Thomassen Port closure device and 2-O PDS sutures. The skin was closed with subcuticular 3-O catgut sutures and steri-strips. Dressings were applied, and the patient tolerated the procedure well. The chest tube did not demonstrate any evidence of air leak and was removed the next day. The patient was discharged on postoperative day 2 with a normal chest X-ray, stable vital signs, and normal blood



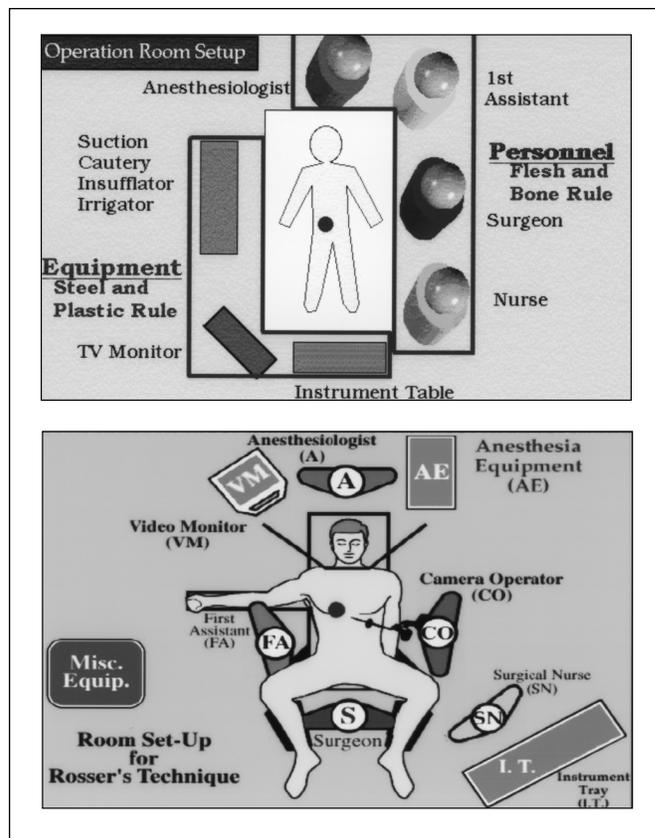
**Figure 3.** Establishment of "Triangle of Success" for Upper Abdominal Region.

work. Postoperative evaluations at one week, one month, and three months were normal.

## DISCUSSION

### Literature Review

Metallic fixation pins and wires are used extensively in the management of fractures and dislocations. The actual incidence of migration of these devices is unknown, although the complication has been well documented and on occasion has been associated with death. Migration is most often to contiguous structures (chest, lung, heart, trachea, spinal canal, orbit, etc), but embolization of foreign bodies through major vascular structures to distant sites has been reported. Lyons and Rockwood<sup>2</sup> described 49 cases of migration in 47 patients in which 17 pins migrated directly to major vascular structures (4 to the heart, 2 to the subclavian artery, 6 to the ascending aorta, and 5 to the pulmonary artery). Eight deaths were attributed to migration, six of which were associated with pericardial tamponade. All eight deaths were in patients who had fixation of the sternoclavicular joint, and all died within three months of operation. Six of these patients were known to have had migration of the pins and all died suddenly. The most common site of origin of migrating pins was the shoulder (sternoclavicular, 21; acromioclavicular, 8; fracture of



**Figure 4A. (top)** Ideal Operative Room Set-up for Personnel and Equipment. **Figure 4B. (bottom)** Ideal Operative Room set-up for Upper Abdominal Laparoscopic Surgical Procedures.

the shaft of clavicle, 7; fracture of the medial portion of the clavicle, 3; arthrodesis shoulder, 3; fracture of the proximal part of the humerus, 3; unstable posterior dislocation of the shoulder, 1; and excisional arthroplasty of the acromioclavicular joint, 1).

An additional unusual case was reported by Goodsett et al<sup>3</sup> describing the migration of a Kirschner wire from a left wrist fracture site to the right ventricle forty-two months postoperatively. The pin was noted by the patient under the skin for some time and then disappeared. It presumably embolized via brachial veins to the heart causing pericardial tamponade. The pin was removed at sternotomy.

Only two reports document the passage of a pin from the shoulder, through the thoracic cavity, to the abdomen. As

reported by Retief et al,<sup>4</sup> one of these pins had been placed to stabilize a right acromioclavicular dislocation six weeks previously. A week prior to admission, the patient fell and experienced acute pleuritic pain. An X-ray was not obtained for a “few” days after the fall, and the pin was seen protruding from the inferior aspect of the shaft of the clavicle in the direction of the apex of the lung. Over the next few days, the pin exhibited aggressive migration to the right upper quadrant. The pin was ultimately retrieved from the posthepatic retroperitoneal space at laparotomy.

In a second case of abdominal migration,<sup>5</sup> a pin was used to stabilize a posterior dislocation of the glenohumeral joint. At laparotomy, the wire was found to be protruding from the costal border of the spleen. The wire was removed, but subsequent hemorrhage necessitated splenectomy.

### **Operative Strategy**

Several technical algorithms were used during the course of this procedure that assisted the operating team in the efficient laparoscopic management of this case. These include the “flesh & bone; steel & plastic” approach to room setup, the establishment of “optical correctness,” the use of the “triangle of success” trocar placement strategy, and the use of the Rosser system for intracorporeal suturing.

The formulation concepts of proper room setup strategy must be based on a standardized personnel/equipment organizational format. This serves to decrease room clutter and allows the team to interface with the equipment with greater ease. It also decreases the procedure equipment requirements and increases ergonomic correctness. First, when applicable, we strive to position all personnel on one side of the table, which is usually the side that is contralateral to the operative site. All of the equipment is placed on the side of the operative site. This has been called the “flesh & bone (personnel); steel & plastic (equipment)” rule (**Figures 4A and 4B**).

The room setup must be closely coordinated with the principle of optical correctness. Optical correctness assures directional stability with respect to the relationship of the actual direction of movement by laparoscopic instruments in the abdomen to the direction of movement of the instruments on the video monitor. Optical correctness is established by having the surgeon, camera, operative site, and video monitor in a linear relationship

with each other. To maintain this instrument directional consistency, the surgeon must never operate looking over the shoulder.

The minimally invasive operative approach to this case was enhanced by the use of a structured trocar site selection strategy. Once the pneumoperitoneum is achieved, the triangle of success is established based on visualization of the operative target. The apex of the triangle is the operative site with the base formed by two trocars. The distance between the operative site and the two trocars should normally be between 20 to 25 cm and is a critical 30 to 40 degrees. An appropriate instrument entry angle allows efficient intracorporeal wrapping during suturing and prevents either the tangling or falling off, or both tangling and falling off, of the suture from the suturing instrument. In addition, the distance between the two trocars establishing the base of the triangle of success should be between 12 to 15 cm. This distance dictates the appropriate “convergence angle” of the instruments over the operative site and prevents the lack of convergence, collisions, and fatigue associated with poor ergonomic positioning produced by a great distance between trocars.

Emphasis should be placed on selection of the sizes of trocars and two-handed intracorporeal suturing techniques. If the operator is right-hand dominant, the needle should be placed into the abdomen with the left hand through the left trocar. A trocar that is at least 10 mm in diameter must be used to allow successful passage of the SH (Ethicon; Somerville, NJ) or V20 (USSC; Norwalk, CT) needle through the trocar. If the operator is left-hand dominant, the suture is placed into the abdomen using the nondominant or right hand. Therefore, a 10-mm trocar is used for the right-sided port of the triangle. The Rosser technique for intracorporeal suturing has been documented in previous publications.<sup>6,7</sup> It differs from other techniques in that the non-dominant hand is extensively used. Preparatory drills are used to improve targeting skills, 2-dimensional depth perception compensation and two-handed choreography. Lastly, a rigidly structured algorithm is used to assist in rapidly establishing intracorporeal suturing capability.

### **CONCLUSION**

Migration of orthopedic fixation pins, particularly when used to stabilize the shoulder and especially after fixation of the sternoclavicular joint, is a known and dangerous

complication of their use. Recommendations previously made by Lyons and Rockwood<sup>2</sup> bear repeating. Patients should be instructed on the importance of notification of their physician with any symptom, such as chest pain or shortness of breath, atypical of their previous course. Close follow-up is essential with periodic radiographs confirming the stability of fixation in all patients, with particular attention to any patient with symptoms potentially related to migration. If any migration of percutaneous pins is noted, the pin should be removed immediately. If an intracorporeal pin migrates, it must be urgently removed, regardless of a lack of symptoms. Finally, fixation of the sternoclavicular joint with pins should not be done because of the extraordinarily high risk of migration.

Laparoscopic removal of foreign bodies of the abdomen can be done safely. This report presents the successful removal of a shoulder fixation pin from the right lobe of the liver with intracorporeal repair of the diaphragmatic laceration. An expeditious workup and urgent operative intervention were required. In addition, attention to the details of strategic operative planning, ie, Rosser's Rules, were needed. Adherence to the principles of room setup, optical correctness, establishment of the triangle of success, appropriate instrument entry and convergence

angles, two-handed surgical skills, and competence in intracorporeal suturing techniques were all required for successful completion of the case.

**References:**

1. Rosser, JC. *The Art of Laparoscopic Suturing* (A CD-ROM Interactive Training Module). Oxford: Radcliffe Medical Press; 1995.
2. Lyons FA, Rockwood, CA. Migration of pins used in operations on the shoulder. *J Bone Joint Surg.* 1990;72-A(8):1262-1267.
3. Goodsett JR, Pahl AC, Glaspy JN, Schapira MM. Kirschner wire embolization to the heart: an unusual cause of pericardial tamponade. *Chest.* 1999;115:291-293.
4. Retief PJ, Meintjes FA. Migration of a Kirschner wire in the body. *So African Med J.* 1978;53:557-558.
5. Potter FA, Fiorini AJ, Knox J, Rajesh PB. The migration of a Kirschner wire from shoulder to spleen: brief report. *J Bone Joint Surg.* 1988;70-B:326-327.
6. Rosser JC, Rosser LE, Savalgi RS. Skill acquisition and assessment for laparoscopic surgery. *Arch Surg.* 1997;132:200-204.
7. Rosser JC, Rosser LE, and Savalgi RS. Objective evaluation in laparoscopic surgical training and credentialing. *Arch Surg.* 1998;133: 657-661.